CLAIMS

Amend the claims as follows.

Claims 1-30. (Cancelled)

31. (Currently Amended) ~~An automated~~ A method of compensating for ~~frequency compensated communications reception including compensating for~~ frequency offset in a received signal ~~by adaptively forming a combination of basis functions and a training sequence that collectively approximate to~~, comprising:

constructing a reference signal comprising a training sequence of the received signal and one or more basis functions;

minimizing a cost function associated with the reference signal, wherein the cost function comprises the training sequence, the one or more basis functions, and the received signal; and

acquiring a desired frequency-shifted signal when the cost function indicates a predetermined degree of correlation between the reference signal and the received signal ~~to be acquired~~.

32. (Currently Amended) The [[A]] method according to Claim 31, wherein a minimum cost function indicates a maximum degree of correlation between the ~~including constructing a~~ reference signal and the received signal ~~or comparison training sequence that is an adaptively formed combination of basis functions and the training sequence~~.

33. (Currently Amended) The [[A]] method according to Claim ~~32~~ 31, wherein the ~~for acquiring a signal with a receiver having multiple antenna elements, the method including constructing the reference signal by minimising a~~ cost function further comprises ~~constructed from an adaptively weighted combination of basis functions, a training sequence and a received signal, together with~~ a constraint to obtain non-trivial solutions.

34. (Currently Amended) The [[A]] method according to Claim 33, wherein the constraint requires non-zero signal power.

35. (Currently Amended) The [[A]] method according to Claim 31, ~~33~~ wherein the cost function is J given by:

$J = \|Xw - CFv\|^2 + \lambda(w^H X^H Xw - 1)$, wherein ~~where~~ X is a matrix of received signal samples, wherein w is a vector of beamforming weights configured ~~which are adaptive~~ to minimize ~~minimise~~ J, wherein C is a diagonal matrix having elements of the training sequence on its diagonal, wherein F is a matrix having columns defining respective basis functions, v is a vector of weights configured ~~which are adaptive~~ to minimize ~~minimise~~ J, wherein superscript index H indicates a complex conjugate transpose, and wherein λ is a Lagrange multiplier for a term to constrain beamformer output power to be non-zero.

36. (Currently Amended) The [[A]] method according to Claim 35, further comprising: ~~including~~

determining the ~~adaptive weight~~ vectors w and v at intervals from ~~true~~ estimates of a correlation matrix determined from multiple data vectors and from inverses of such estimates recursively updated to reflect successive new data vectors which are rows of the matrix X.

37. (Currently Amended) The [[A]] method according to Claim 36, wherein the ~~including recursively updating~~ inverse correlation matrices are recursively updated by:

~~a)~~ forming a vector u(n) having a first element $u_1(n)$ equal to $\sqrt{U_{1,1(n)}}$ and other elements $u_p(n)$ (p= 2 to M) which are respective ratios $U_{p,1}(n)/u_1(n)$, $U_{p,1}(n)$ is a pth element of a first column of a matrix U(n), wherein the matrix $U(n) = u(n)u^H(n) = x(n)x^H(n) - x(n-K+1)x^H(n-K+1)$, wherein x(n) is a most recent data vector, ~~and~~ wherein $x(n-K+1)$ is a least recent data vector involved in updating, and wherein $x(n)x^H(n)$ and $x(n-K+1)x^H(n-K+1)$ are correlation matrices;

~~b)~~ premultiplying a previous inverse correlation matrix P(n -1) by vector $u^H(n)$ and postmultiplied by vector u(n) to form a product; ~~and~~

adding the product to a forget factor to form a sum;

~~e)~~ postmultiplying the previous inverse correlation matrix P(n -1) by vector u(n) to form a second product; ~~and~~

dividing the second product by the ~~said~~ sum to form a quotient; and

~~d)~~ subtracting the quotient from the previous inverse correlation matrix P(n -1) to provide a difference.

38. (Currently Amended) The [[A]] method according to Claim 31, wherein the received signal is acquired by ~~32 for acquiring a signal with a receiver having~~ a single antenna element~~, the method including constructing the reference signal by minimising a cost function constructed from an adaptively weighted combination of basis functions, a scaled received signal and a constraint requiring non-zero signal power~~.

39. (Currently Amended) The [[A]] method according to Claim 38, wherein the cost function is J given by:

$J = \|x - CFv\|^2$, wherein ~~where~~ x is a vector of received signal samples, wherein C is a diagonal matrix having elements of the training sequence on its diagonal, wherein F is a matrix having columns defining respective basis functions, and wherein v is a vector of weights configured to minimize J ~~and v, C and F are as defined earlier~~.

40. (Currently Amended) The [[A]] method according to Claim 38, wherein the cost function is J given by:

$J = \|\alpha x - Gv\|^2 + \lambda(\alpha^* x^H x\alpha - 1)$, wherein ~~where~~ α is a scaling factor, wherein x is a vector of received signal samples, wherein C is a diagonal matrix having elements of the training sequence on its diagonal, wherein F is a matrix having columns defining respective basis functions, wherein G is a matrix equal to CF, wherein v is a vector of weights configured to minimize J, wherein superscript index H indicates a complex conjugate transpose, and wherein λ is a Lagrange multiplier for a term to constrain beamformer output power to be non-zero ~~and v, λ, C, F and H are as defined earlier~~.

41. (Currently Amended) An Apparatus configured to compensate ~~for frequency compensated communications reception including means for compensating~~ for frequency offset in a received signal, wherein the apparatus comprises:

means for constructing a reference signal comprising one or more ~~by adaptively forming a combination of~~ basis functions and a training sequence, wherein the means for constructing the reference signal is configured to minimize a cost function comprising the one or more basis functions, the training sequence, and the received signal; and

means for acquiring ~~that collectively approximate to~~ a desired frequency-shifted signal when the cost function indicates a predetermined degree of correlation between the reference signal and the received signal ~~to be acquired~~.

42. (Cancelled)

43. (Currently Amended) The Apparatus according to Claim ~~42 having a receiver with~~ 41, wherein the means for acquiring comprises multiple antenna elements ~~for acquiring the received signal, the apparatus including means for constructing the reference signal by minimising a cost function constructed from an adaptively weighted combination of basis functions, a training sequence and a received signal, together with a constraint to obtain non-trivial solutions~~.

44. (Currently Amended) The Apparatus according to Claim 43, wherein the cost function further comprises a constraint to obtain non-trivial solution, and wherein the constraint requires non-zero signal power.

45. (Currently Amended) The Apparatus according to Claim ~~43~~ 41, wherein the cost function is J given by:

$J = \|Xw - CFv\|^2 + \lambda(w^H X^H Xw - 1)$, wherein ~~where~~ X is a matrix of received signal samples, wherein w is a vector of beamforming weights configured ~~which are adaptive~~ to minimize ~~minimise~~ J, wherein C is a diagonal matrix having elements of the training sequence on its diagonal, wherein F is a matrix having columns defining respective basis functions, v is a vector of weights configured ~~which are adaptive~~ to minimize ~~minimise~~ J, wherein superscript index H indicates a complex conjugate transpose, and wherein λ is a Lagrange multiplier for a term to constrain beamformer output power to be non-zero.

46. (Currently Amended) The Apparatus according to Claim 45, further comprising: ~~including~~

means for determining the ~~adaptive weight~~ vectors w and v at intervals from ~~true~~ estimates of a correlation matrix determined from multiple data vectors and from inverses of such estimates recursively updated to reflect successive new data vectors which are rows of the matrix X.

47. (Currently Amended) The Apparatus according to Claim ~~46~~ 45, further comprising ~~including~~ means for recursively updating inverse correlation matrices by:

~~a)~~ forming a vector u(n) having a first element $u_1(n)$ equal to $\sqrt{U_{1,1(n)}}$ and other elements $u_p(n)$ (p= 2 to M) which are respective ratios $U_{p,1}(n)/u_1(n)$, $U_{p,l}(n)$ is a pth element of a first column of a matrix U(n), wherein the matrix U(n) = $u(n)u^H(n)=x(n)x^H(n)-x(n-K+1)x^H(n-K+1)$, wherein x(n) is a most recent data vector, ~~and~~ wherein $x(n-K+1)$ is a least recent data vector involved in updating, and wherein $x(n)x^H(n)$ and $x(n-K+1)x^H(n-K+1)$ are correlation matrices;

~~b)~~ premultiplying a previous inverse correlation matrix P(n -1) by vector $u^H(n)$ and postmultiplied by vector u(n) to form a product; ~~and~~

adding the product to a forget factor to form a sum;

~~c)~~ postmultiplying the previous inverse correlation matrix P(n -1) by vector u(n) to form a second product; ~~and~~

dividing the second product by the ~~said~~ sum to form a quotient; and

~~d)~~ subtracting the quotient from the previous inverse correlation matrix P(n -1) to provide a difference.

48. (Currently Amended) The Apparatus according to Claim ~~42 having a receiver with~~ 41, wherein the means for acquiring comprises a single antenna element, and wherein the single antenna is configured to product a single output signal for any given sample time ~~for acquiring the received signal, the apparatus including means for constructing the reference signal by minimising a cost function constructed from an adaptively weighted combination of basis functions, a scaled received signal and a constraint requiring non-zero signal power~~.

49. (Currently Amended) The Apparatus according to Claim ~~48~~ 41, wherein the cost function is J given by:

$J = \|x - CFv\|^2$, wherein ~~where~~ x is a vector of received signal samples, wherein C is a diagonal matrix having elements of the training sequence on its diagonal, wherein F is a matrix having columns defining respective basis functions, and wherein v is a vector of weights configured to minimize J ~~and v, C and F are as defined earlier~~.

50. (Currently Amended) The Apparatus according to Claim ~~48~~ 41, wherein the cost function is J given by:

$J = \|\alpha x - Gv\|^2 + \lambda(\alpha^* x^H x\alpha - 1)$, wherein ~~where~~ α is a scaling factor, wherein x is a vector of received signal samples, wherein C is a diagonal matrix having elements of the training sequence on its diagonal, wherein F is a matrix having columns defining respective basis functions, wherein G is a matrix equal to CF, wherein v is a vector of weights configured to minimize J, wherein superscript index H indicates a complex conjugate transpose, and wherein λ is a Lagrange multiplier for a term to constrain beamformer output power to be non-zero ~~and v, λ, C, F and H are as defined earlier~~.

51 . (Currently Amended) A computer-readable medium having stored thereon, computer-executable instructions that, if executed by a system, cause the system to perform a method comprising: ~~computer software product comprising a computer readable medium containing computer readable instructions for controlling operation of computer apparatus for use in frequency compensated communications reception, wherein the computer readable instructions provide a means for controlling the computer apparatus to compensate for frequency offset in a received signal by adaptively forming a combination of basis functions and a training sequence that collectively approximate to~~

constructing a reference signal comprising an original training sequence and a plurality of sinusoidal basis functions;

minimizing a cost function associated with the reference signal, wherein the cost function comprises the original training sequence, the plurality of basis functions, and a received signal; and

acquiring a desired frequency-shifted signal when the cost function indicates a predetermined degree of correlation between the reference signal and the received signal ~~to be acquired~~.

52. (Currently Amended) The computer-readable medium ~~A computer software product~~ according to Claim 51, wherein the method further comprises: ~~computer readable instructions provide a means for~~

constructing a ~~reference signal or~~ comparison training sequence that is an adaptively formed combination of the basis functions and the original training sequence.

53. (Currently Amended) The computer-readable medium ~~A computer software product~~ according to Claim 51, wherein the ~~52 for use in processing received signals acquired by a receiver with multiple antenna elements, wherein the computer readable instructions provide a means for for constructing the reference signal by minimising a~~ cost function further comprises ~~constructed from an adaptively weighted combination of basis functions, a training sequence and a received signal, together with~~ a constraint to obtain non-trivial solutions, and wherein the constraint requires non-zero signal power.

54. (Cancelled)

55. (Currently Amended) The computer-readable medium ~~A computer software product~~ according to Claim ~~53~~ 51, wherein the cost function is J given by:

$J = \|Xw - CFv\|^2 + \lambda(w^H X^H X w - 1)$, wherein ~~where~~ X is a matrix of received signal samples, wherein w is a vector of beamforming weights configured ~~which are adaptive~~ to minimize ~~minimise~~ J, wherein C is a diagonal matrix having elements of the training sequence on its diagonal, wherein F is a matrix having columns defining respective basis functions, v is a vector of weights configured ~~which are adaptive~~ to minimize ~~minimise~~ J, wherein superscript index H indicates a complex conjugate transpose, and wherein λ is a Lagrange multiplier for a term to constrain beamformer output power to be non-zero.

56. (Currently Amended) The computer-readable medium ~~A computer software product~~ according to Claim 55, wherein the method further comprises: ~~computer readable instructions provide a means for~~

determining the ~~adaptive weight~~ vectors w and v at intervals from ~~true~~ estimates of a correlation matrix determined from multiple data vectors and from inverses of such estimates recursively updated to reflect successive new data vectors which are rows of the matrix X.

57. (Currently Amended) The computer-readable medium ~~A computer software product~~ according to Claim ~~56~~ 55, wherein the method further comprises ~~computer readable instructions provide a means for~~ recursively updating inverse correlation matrices by:

~~a)~~ forming a vector u(n) having a first element $u_1(n)$ equal to $\sqrt{U_{1,1(n)}}$ and other elements $u_p(n)$ (p= 2 to M) which are respective ratios $U_{p,1}(n)/u_1(n)$, $U_{p,1}(n)$ is a pth element of a first column of a matrix U(n), wherein the matrix U(n) = $u(n)u^H(n)=x(n)x^H(n)-x(n-K+1)x^H(n-K+1)$, wherein x(n) is a most recent data vector, ~~and~~ wherein $x(n-K+1)$ is a least recent data vector involved in updating, and wherein $x(n)x^H(n)$ and $x(n-K+1)x^H(n-K+1)$ are correlation matrices;

~~b)~~ premultiplying a previous inverse correlation matrix P(n -1) by vector $u^H(n)$ and postmultiplied by vector u(n) to form a product; ~~and~~

adding the product to a forget factor to form a sum;

~~c)~~ postmultiplying the previous inverse correlation matrix P(n -1) by vector u(n) to form a second product; ~~and~~

dividing the second product by the ~~said~~ sum to form a quotient; and

~~d)~~ subtracting the quotient from the previous inverse correlation matrix P(n -1) to provide a difference.

58. (Currently Amended) The computer-readable medium ~~A computer software product~~ according to Claim 51, wherein the ~~52 for use in processing~~ received signal is ~~signals~~ acquired by a receiver comprising ~~with~~ a single antenna element~~,~~ ~~wherein the computer readable instructions provide a means for constructing the reference signal by minimising a cost function constructed from an adaptively weighted~~

~~combination of basis functions, a scaled received signal and a constraint requiring non-zero signal power~~.

59. (Currently Amended) The computer-readable medium ~~A computer software product~~ according to Claim 58, wherein the cost function is J given by:

$J = \|x - CFv\|^2$, wherein ~~where~~ x is a vector of received signal samples, wherein C is a diagonal matrix having elements of the training sequenee on its diagonal, wherein F is a matrix having eolumns defining respeetive basis funetions, and wherein v is a vector of weights eonfigured to minimize J ~~and v, C and F are as defined earlier~~.

60. (Currently Amended) The eomputer-readable medium ~~A computer software product~~ aeeording to Claim 58, wherein the eost funetion is J given by:

$J = \|\alpha x - Gv\|^2 + \lambda(\alpha^* x^H x \alpha - 1)$, wherein ~~where~~ α is a scaling faetor, wherein x is a veetor of reeeived signal samples, wherein C is a diagonal matrix having elements of the training sequenee on its diagonal, wherein F is a matrix having columns defining respeetive basis funetions, wherein G is a matrix equal to CF, wherein v is a veetor of weights configured to minimize J, wherein superseript index H indicates a eomplex eonjugate transpose, and wherein λ is a Lagrange multiplier for a term to eonstrain beamformer output power to be non-zero ~~and v, λ, C, F and H are as defined earlier~~.

61. (New) The method aeeording to Claim 31, wherein the one or more basis funetions eomprise a sinusoid.

62. (New) The apparatus aeeording to Claim 42, wherein the one or more basis span a subspaee in whieh a complex sinusoid assoeiated with the frequeney offset lies.